INTERNATIONAL SPACE STATION
TELECONFERENCE

Some Assembly Required

LIVE! via satellite
February 18, 1999
12:30 - 2:00 PM (ET)

Student Materials

NASA
Fortieth Anniversary
Pioneering the Future

WHRO

Introducing the International Space Station

Right now, circling overhead, is a new star on the horizon! It's part of an orbiting research laboratory called the International Space Station **(ISS)**! Astronauts, engineers and scientists from around the world are working cooperatively to design, construct, launch and assemble the world's largest space laboratory. Imagine trying to assemble a laboratory the size of a football field while orbiting the earth! Top it off by coordinating this effort with 15 other nations! Some assembly is required for ISS!

The success of the ISS depends on the collaboration of all the countries involved to share their expertise and resources. This venture is the largest international space program in history.

The first two components were launched from opposite sides of the world to meet in space. For updates and more, check out the web site below!

http://station.nasa.gov/index-m.html

New Star on the Horizon

Like other satellites, you can look up into the sky and see the ISS! On orbit assembly began in 1998, and ISS grows brighter as each component is delivered to space. Visit this web site to track ISS:

http://www.spaceflight.nasa.gov/realdata/sightings/index.html

How and when will the assembly take place?

It will take 5 years and over 40 space flights to bring the over 100 components together! The program involves more than 100,000 people at space agencies and hundreds of contractor and subcontractor companies around the world.

Why do we need a laboratory in space?

Think about the scientific research we conduct here on Earth. How would the scientific processes or results change if we conducted the experiment in microgravity? Space shuttle missions helped scientists discover that microgravity changes the way cells and molecules form and grow!

Researchers also realized that long-duration research is necessary for further understanding of how these changes can help us improve those same scientific processes back on earth. Whether its protein creation, cellular generation, or seed germination, scientists, engineers and astronauts work together in space to discover ways to improve life on Earth.

Part I. Assembling the People

What nations are involved in the International Space Station?

The ISS is INTERNATIONAL because 16 nations from around the world are working together to design and build the station. The United States is leading the global community in the construction of the ISS, paving the way for peaceful cooperation in space exploration into the next century. The station is taking shape in facilities, factories and laboratories in the U.S. and around the world.

United States
Russia
Japan
Canada
Brazil
Belgium
Denmark
France
Germany
Italy
Netherlands
Norway
Spain
Sweden
Switzerland
United Kingdom

Activity

Find each country on a map and read about the people who live there. Go to the Space Station Web page to learn more about their ISS activities!
http://station.nasa.gov/station/index.html

Think About It!

Think about all the languages and cultures involved in this project! How could this affect working together? Many times meaning can be lost in the translation! Do the scientists and engineers from Japan use the same computers as Russia? What are the protocols used in Mission Control?

STS 100 Crew
(left to right)

Cosmonaut Yuri Gidzenko is the pilot commander for the Russian Soyuz vehicle.

Astronaut William M. Shepherd is the commander of the expedition mission.

Cosmonaut Sergei Krikalev is the flight engineer of this expedition.

The first crew to live and work on the Space Station will be two Russian cosmonauts and one American astronaut. The crew spent years training together learning communication skills, assembly procedures, and the basics of living and working together in a new weightless environment.

Activity

What do the ISS crewmembers have in common? How are they different? Write a biographical essay, compose a bio-poem, or create an international biographical dictionary on some of the crew members of the ISS. To find out more about each crewmember, check out **http://www.jsc.nasa.gov/Bios/**

What's Cooking in Space?

Do astronauts eat pizza in space? Who determines the crew's menu on the ISS? Who prepares the food? Did you know that NASA has a food lab where nutritionists work with astronauts to determine the nutritional value of the food eaten? Menus are planned well in advance, taking into account the daily nutritional values needed to maintain good health.

Will astronauts eat fresh fruits and vegetables? Imagine being a nutritionist who must help plan a well-balanced diet for the crews, but not being able to include fresh fruits and vegetables. Since there will not be any refrigerators on Space Station, scientists and engineers must find different methods of food preservation and design packaging that will keep food fresh for longer periods of time. Many of these methods are also used in preserving the foods we eat here on Earth!

Activity

Below is a list of food **Astronaut Robert Cabana** ate for breakfast on day seven of the first ISS mission. Can you correctly guess which of the methods of **preparation / preservation** is used for each item?

- **Dehydrated** – water is removed from food
- **Thermostabilized** - cooked at moderate temperatures and sealed
- **Irradiated** - food is exposed to ionizing radiation

Sausage Pattie	Oatmeal w/Raisins	Breakfast Roll
Dried Apricots	Grapefruit Drink	Coffee w/cream and sugar

To find the answers, visit this web site!
http://38.201.67.70/shuttle/crew/crewmenu.html

Astronauts and cosmonauts eat four times per day, three meals and one snack. These meals are a combination of Russian and American food. The Russian food is heated in an oven similar to that used on the Russian Space Station MIR. Unfortunately, the packaging for the American food is too big to fit in this oven. So, engineers designed a portable food warmer -- so portable, it resembles a suitcase!

What was the first food eaten in space by a US astronaut? John Glenn ate applesauce from a tube during his Mercury program flight on February 20, 1962.

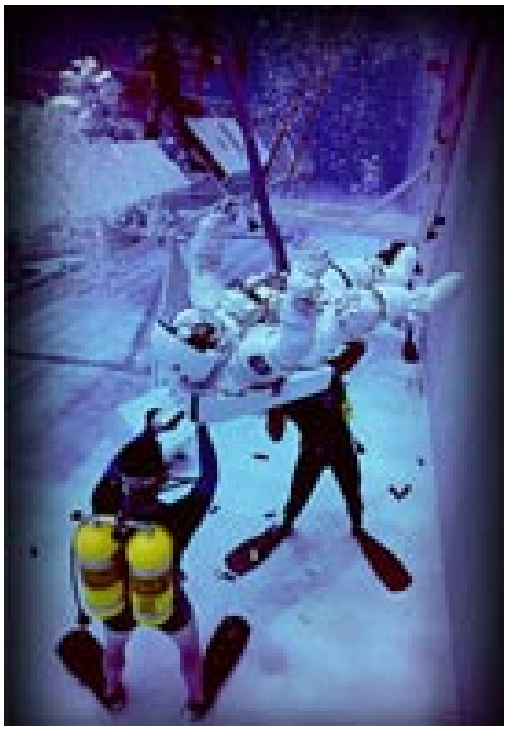
For more food facts check out this web site!
http://38.201.67.70/shuttle/reference/factsheets/food.html

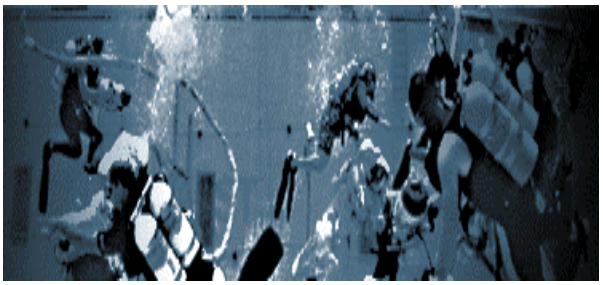
Training for ISS

Training and practicing for the world's largest construction job in space requires a special environment that simulates microgravity.

Microgravity is the condition in space often referred to as free-fall or weightlessness. Astronauts in space are actually in a "falling" in an orbit around the Earth, floating at the same rate as their spacecraft.

Think about the last time you were on a roller coaster with a big drop-- your arms and legs felt light and "floated" up into the air. You were experiencing an effect called free-fall or microgravity. Gravity is still acting upon you but you don't feel its effects! You are falling at the same rate as the roller coaster. Astronauts will experience a similar effect in the Space Station as it "falls" in a continual orbit around Earth.





Neutral buoyancy is the term used to describe something that has an equal tendency to float as it does sink. Articles that are configured to be *neutrally buoyant* -- accomplished with a combination of weights and flotation devices -- seem to "hover" under water. Neutrally buoyant items can be easily manipulated underwater, much like in orbit.

NASA engineers have created the Neutral Buoyancy Lab (NBL) to simulate the weightlessness that is experienced by a crew during space flight. The NBL is an essential tool for the design, testing and development of the International Space Station. The facility provides training for space walks, or extravehicular activities (EVA).

In this underwater simulation site, they will become familiar with working in their space suits as they learn to assemble the ISS! Even the simplest of tasks like using a wrench can be troublesome!

Part II. Assembling the Parts

The first two elements of the ISS, Unity and Zarya, were assembled in December, 1998 during the STS-88 mission. Astronauts Jerry Ross and Jim Newman performed a series of extravehicular activities or spacewalks.

Visit this web page for more on ISS assembly:
http://spaceflight.nasa.gov/station/assembly/index.html

EVA 1 During the first EVA, Ross and Newman made all power connections necessary to activate Unity. Upon completion of the connections, mission control sent electronic commands to Unity to confirm power and activation.

EVA 2 Tasks completed during the second EVA included installation of EVA tools, such as handrails and foot restraint sockets, installation of the early communications system antennas and routing of the communications cables from the Zarya to the Unity.

EVA 3 The third scheduled EVA included installation of a large tool bag for storing EVA tools outside the station. Following the completion of the three EVA's, the Space Shuttle undocked from the ISS.

Visit this web page for more on ISS assembly:
http://spaceflight.nasa.gov/station/assembly/index.html

Building a Laboratory in Space

Imagine trying to fit your classroom science lab into a shoebox -- and still have the nutrients, water, air and temperature control required! Then include power to collect and transmit data.

While it may seem impossible, scientists and engineers custom design the housing for each experiment on ISS. This housing, called a habitat, is designed to fit into a holding rack that provides life support resources and electrical power to the experiment. The habitats can be rearranged within the rack to allow equipment to be removed or new equipment to be inserted for specific experiments.

Part III. Research on the ISS

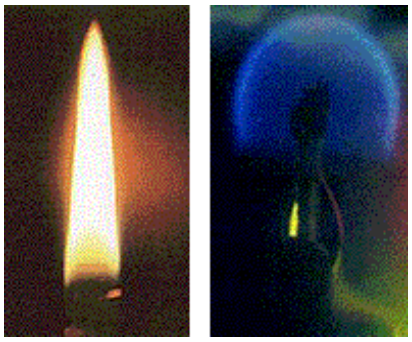
Some of the areas that scientists will study on the ISS are **fluid physics, materials science, biotechnology** and **combustion science:**

Fluid Physics
is the study of the behavior of liquids and gasses.

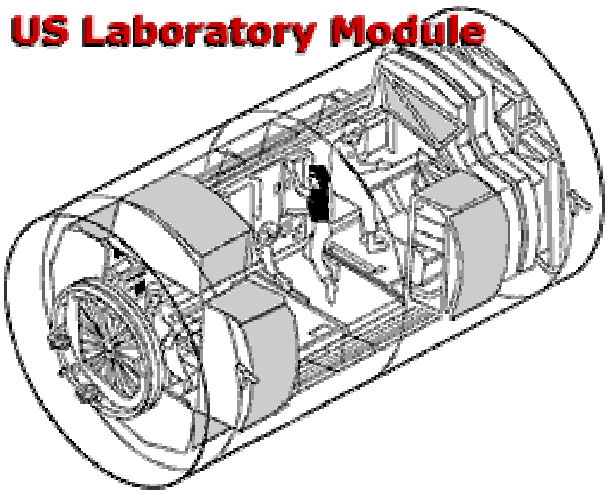
Materials Science
is the study of the behavior of materials, how they form and change.

Biotechnology
examines cell culturing and protein crystal growth.

Combustion Science
studies the process of combustion, such as how flames burn.



Combustion meets almost 85% of the world's energy needs. Combustion research aboard the ISS may lead to enhanced energy efficiency and reduced pollution.



Visit the Space Station Home Page to find out more!

http://station.nasa.gov/station/index.html

Studying Processes

What effect does microgravity have on the scientific process and the human body?

By now it must be obvious how gravity affects everything we do on Earth! Do you realize that gravity effects us, right down to the tiniest molecule -- even how these molecules move and change? Some of these changes, or processes, happen differently in space than they do on Earth. For scientists, this means making discoveries and finding new ways of conducting research – and the ISS will be the place to do it.

Gravity Fact

Did you know that in space, an astronaut's face swells up due to fluids not being pulled down by the force of gravity? This phenomenon is sometimes called "puffy face".

What are these processes?

Convection – Energy and/or mass transfer in a fluid by means of bulk motion of the fluid.

Buoyancy-Driven Convection – Convection created by the difference in density between two or more fluids in a gravitational field.

Diffusion – The atoms or molecules of a solid, liquid or gas move from an area of high concentration to an area of low concentration.

Sedimentation – The tendency of a dense material to settle to the bottom of a mixture.

Surface Tension – Tendency of the surface of a liquid to behave as if it were an elastic membrane.

Activity

Have you ever realized the scientific processes that occur when you make a cup of hot chocolate? Match the following steps with the processes below.

A. *Heat* water to a boil	_____	**Sedimentation**
B. Combine water and powdered mix	_____	**Diffusion**
C. Smell of chocolate *spreads* through the air	_____	**Convection**
D. Marshmallows *floating* on top	_____	**Surface Tension**
E. Chocolate left at the bottom of your cup	_____	**Buoyancy-Driven Convection**

One Planet, One Chance!

The ISS will benefit Earth and humankind in many ways. ISS will help us collect data on scientific phenomenon that can be observed better from space.

Our Changing World

Since the 1950's, it has become increasingly clear that human activities are modifying the composition of the atmosphere on a global scale. These trends have created issues of global interest including global warming and declining levels of ozone.

Monitoring the Environment from Space

We hear about the depletion of the Earth's ozone layer and the change in the world's climate. Did you know that Space Station plans to carry equipment that will monitor the Earth's atmosphere?

Because the ozone layer protects the Earth's surface and its inhabitants from harmful ultraviolet radiation, it's extremely important that we keep a constant and accurate track of its status – changes in its density and the rate at which these changes occur. The International Space Station will enhance our understanding of natural and human-derived atmospheric processes by providing accurate long-term measurements of aerosols, ozone, water vapor and other important gases in the Earth's atmosphere.

World Changes

Monitoring the Earth has already allowed us to learn more about protecting our planet and ourselves. The scientific community has made great strides in cleaning up the environment.

Cool!

The laws have been changed! Air conditioners in automobiles are now regulated to prevent dangerous emissions that are harmful to our atmosphere.

The Future is Yours

As we expand our understanding of the world around us, we are better able to make decisions to protect our planet!

To find out more about the environmental research planned for the Space Station, visit:
http://www-arb.larc.nasa.gov/sage3/